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SPRAYING GRAPES

With Special Reference to Black Rot

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The black rot fungous plant produces spores, "seeds," which begin to be liberated very early in the spring. All parts of grapevines above ground may be affected and hence serve as production and distribution centers of spores. The overwintering black rot mummies in the form of dark colored shriveled berries are a source of infection and as many of these as possible should be gathered and destroyed before growth begins in the spring.

Observations have shown that black rot is much more abundant in vineyards in which mummied berries are present than where they have been removed. The mummies may be gathered at pruning time and burned or buried deeply. If many are present on the ground they should be raked up and destroyed. Early spring plowing is of value in covering scattered berries and leaves, thus eliminating them as a disease factor. Such a practice is a commendable one, anyhow, from a cultural treatment standpoint. Prunings, especially in badly infected, vineyards should be removed and destroyed. Studies in Delaware have shown that lesions on the canes are an important source of early leaf and fruit infection.

With such sanitary measures to remove much of the source of infection, the value from spraying will be greatly increased. Without it, spraying may fail to give practical control, at least where the carry-over of the disease from the year before is very great. Spraying (and sanitary treatment as well) is cumulative in its effect. As the amount of disease is reduced from year to year, there will be fewer sources for the production of spores the following season. In vineyards where black rot has been bad in the past, and with weather favorable to the disease, as much as 25 per cent of the crop has been reported as affected the first spraying season. The second year, with the season equally favorable to the development of the disease, the amount of rot was less than 1 per cent.

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Most seasons the first infections occur very early in the growth of the new shoots. At this time it is the leaves and young succulent stems that are affected. Fruit infections occur with rains after the petals are pushed off, exposing that part of the flower which develops into the berry. *Unless it is unusually dry, most of the fruit infections will have taken place by the time the blooming period is over or shortly thereafter, although rotting of the fruit may not develop until the fruit has reached considerable size—giving the impression that the infections occurred somewhat later than was the case.* If the early part of the season is dry the period of heaviest infections may occur somewhat later in the spring.

In general, two prebloom sprays are recommended, one when the new shoots are 8 to 12 inches long or as the flower buds separate, the other just before or just as blooming begins. The latter is usually the most important of all the sprays to protect the fruit, and its omission in vineyards where black rot is present is almost certain to result in a considerable number of affected berries regardless of later spraying. In Florida, a full bloom spray has been reported as of value. With an apparently longer blooming period of grapes than is normal in Missouri, such might well need to be a regular practice in that section. A report of five years' experiments from 1929 to 1933 in Arkansas on the Concord variety is to the effect that 2 and 3 prebloom sprays did not increase control beyond the standard program of (1) just before blooming, (2) just after blooming, and (3) 2 weeks later. Also, the use of heavier dosages of copper and lime than a 4-4-50 Bordeaux mixture did not add to the effectiveness of the sprays. Mention is not made of the severity of black rot in the test vineyards. In north Missouri, a similar program with 3-3-50 and 3-2-50 formulae has proved adequate where there has been no previous build-up of the disease.

The value of a dormant spray for black rot control is not definitely known but is generally recommended where anthracnose is present. There is evidence from Delaware, however, that a delayed dormant spray when the new growth is about $\frac{1}{2}$ inch long will reduce carryover infections of both black rot and anthracnose as well as several other diseases.

A basic 5-spray program is recommended for the control of black rot where the disease has been troublesome in the past. The same schedule is effective against anthracnose and with the addition of lead or calcium arsenate is usually adequate to control the grape berry moth and other early leaf-eating insects. Sprays for late season rots, leaf hoppers, and leaf folders are discussed under these headings:

Delayed Dormant—When the buds have pushed out to a length of about one-half inch.	Bordeaux mixture 12-12-100.
First Summer Spray—When the new shoots are 8 to 12 inches long, or as the flower buds separate.	8-8-100 Bordeaux mixture with 3 lbs. lead arsenate for chewing insects.
Second Summer Spray—Just before or just as the blossoms begin to open.	(Same as above.)
Third Summer Spray—As the blooming period ends.	(Same as above.)
Fourth Summer Spray—From 10 to 14 days after the preceding spray.	8-8-100 Bordeaux mixture with 2 lbs. lead arsenate, or calcium arsenate may be used in the place of lead arsenate to reduce residues.

Local or seasonal conditions may require some modifications of this schedule.

Where there is any great risk of black rot the interval between the early sprays should not exceed 12 to 14 days, and *with very rainy weather especially during the critical period from just before bloom to the setting of the fruit, sprays might well be applied within 10 days of one another. To meet these conditions an additional early spray may need to be applied some years, and it will come during the blooming period.* In those years when the blooming time is long, an extra spray is likely to be needed before the regular application at the end of the blooming period. Also, if the spray just before blooming begins is applied a few days early and the next one delayed until after the fruit has set, the interval between applications may run into a period of three weeks or more. *It is to avoid such long intervals between sprayings that modifications in the basic schedule is advisable.* If rainy weather prevails a third after-bloom spray may prove valuable applied about 3 weeks after the fruit has set or 10 to 12 days after the *Fifth Summer Spray.* Use 8-8-100 Bordeaux.

On the other hand, where little or no black rot has been present in recent years and especially if the weather is unfavorable to its development sprays (1) just before bloom, (2) at the end of the blooming period and (3) about 2 weeks later have been found adequate in this section on Concord, Moore Early and other of the less susceptible black rot varieties.

Good coverage is important. This is best attained by the so-called trailer method where the nozzles are directed by hand rather than fastened to stationary structures, and by breaking up the spray into a fine mist. One or a cluster of two medium capacity disc nozzles on a 3 or 4 foot rod will permit better handling and give a better type of spray than modern tree equipment. One nozzle is enough early in the spring when the leaves are small, with 2 nozzles after the growth becomes more dense. Both the under and upper sides of the leaves should be covered. Best coverage of the fruit is obtained by directing a fine mist to the clusters without getting the nozzles too close to them. Just an instant is long enough to give numerous droplets on

the berries. If too much material is applied, or the force of the spray is too great, the droplets will enlarge and run off. Spraying should be done on each side of each row rather than by applying it from every other middle.

Late Season Rots: Ordinarily, spraying after the fruit is about two-thirds grown is unnecessary for black rot control, but with rainy spells it or some of the summer rots may develop. At this time of the year a non-staining or lightly staining spray such as 3 lbs. of basic or neutral copper acetate to 100 gallons of water should be applied at 10-day to 2-week intervals, so long as weather conditions remain favorable to diseases. This may extend to within a few weeks of ripening time. The late rots are rarely of any consequence outside of southeast Missouri, but in this section may become a matter of considerable concern.

Leaf Hoppers: Where leaf hoppers have been troublesome, a nicotine spray, 1 pint to 100 gallons of water, should be applied just before the first young on the undersides of the leaves acquire wings. This usually will be about the middle of June, possibly a little earlier in south Missouri and a little later in north Missouri. About 3 lbs. of potash fish oil soap will increase the effectiveness of the spray and may be added if no arsenical is used at this time. About 2 lbs. of a hard soap can also be used but is more difficult to dissolve. *Do not add soap if lead arsenate or calcium arsenate is used in the spray.* Calcium caseinate (Kayso) or a similar casein spreader, ½ lb. to 100 gallons, may be used with the nicotine sulfate in the place of soap to increase effectiveness. The casein materials are safe with the arsenicals. If Bordeaux mixture is used at this time no soap, casein or other supplement for the nicotine sulfate need be added. Where leaf hoppers are serious, another spray should be applied again in about 3 weeks. If leaf hoppers are serious enough to need the first spray, a second one will almost always be advisable. The Concord, fortunately, is not very susceptible to leaf hoppers. In applying the spray, special attention should be given to thoroughly cover the *under* sides of the leaves to wet the insects.

Leaf Folders: Grape leaf folders have been causing considerable damage in recent years, sometimes even in regularly sprayed vineyards, probably because the use of arsenicals is usually discontinued soon after the blooming period. As soon as the very first folded leaves are noticed, spray with calcium arsenate preferably; or lead arsenate, 2 lbs. to 100 gallons of water. If folding of the leaves continues, apply another spray a week to 10 days later. Once the leaves are folded, few of the insects will be killed, but by applying poison promptly when the first insects appear damage from later "worms" can be largely avoided. Direct the spray to the upper sides of the leaves, where the insects feed. It is not only unnecessary to cover all parts of the vines but undesirable from the standpoint of residue on the fruit.